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shadows were, however, of appreciable size, so that it was possible to study them to some extent as *surfaces* and not as mere *points*. Then, too, the shadow of III was much larger than that of I, which should tend to reduce somewhat the effect of contrast. The difference of brightness in the backgrounds was carefully considered at the time of observation, and, after making what was considered an ample allowance for any such effect, the shadow of I appeared to have a decidedly more brownish color than the shadow of III.

Powers of 270 and 520 were used. The latter power, especially, gave the shadows sufficiently large disks for me to feel very certain of the color in that of I, and to feel equally certain that the blackness of III was real. The difficulty of properly interpreting such an observation is fully recognized.

It is seldom that the shadows of two of the satellites fall together upon favorable portions of the planet's surface for such an observation as the above. My reason for publishing this single observation is to call it to the attention of observers having the use of large telescopes, in the hope that they may take advantage of any opportunity to compare the density of the shadows of any of the satellites.

There can be little doubt of the absence of sensible atmosphere upon the Jovian satellites, and in that event any light in their shadows would have an important bearing on the physical condition of *Jupiter*. Such a condition, if established, would go far toward proving the high internal temperature of that planet and explaining the rosy color of the equatorial belts.

MT. HAMILTON, January 25, 1906.

C. D. PERRINE.

#### THE SIXTH AND SEVENTH SATELLITES OF *JUPITER* AT THE OPPOSITION OF 1905-1906.

The sixth satellite was first observed, at the present opposition, on July 24th by Mr. ALBRECHT, Fellow in Astronomy at the Lick Observatory, with the Crossley reflector. He had the assistance of Mr. ELLIOT SMITH, also Fellow at the Observatory.

The satellite was then in position-angle  $56^{\circ}.6$  and at a distance of  $26'.0$  from its primary. A comparison with Dr. Ross's ephemeris, printed in *L. O. Bulletin* No. 78, indicated a lengthening of his period to 251 days and small corrections

to the other elements. This satellite reached west elongation about October 1, 1905, and at present is passing eastern elongation. This is the fourth elongation reached since its discovery.

It is now known that this satellite, as well as the seventh, is revolving about *Jupiter* in the same direction as the other satellites of the Jovian system,—i. e. the motion is direct.

An approximate reduction of the observation of January 4th gives the following residuals from Dr. Ross's revised ephemeris in *A. N.* No. 4042:—

Position-angle (Obs. — Eph.) . . . . .	+ 0°.4
Distance (Obs. — Eph.) . . . . .	— 0'.4

This is a close agreement, when the approximate nature of the ephemeris and observation is considered.

The seventh satellite was first reobserved on August 7th by Mr. ALBRECHT, using the Crossley reflector. Its position-angle was 289°.7 and distance 54'.6. A comparison of this position with Ross's ephemeris published in *L. O. Bulletin* No. 82 shows that the satellite was over a month in advance of its predicted place. On October 24th, however, it was only about a week in advance of its ephemeris place. This condition, taken in connection with the fact that western elongation was at a much greater distance than predicted, indicates that the eccentricity is much larger than 0.02, Dr. Ross's value.

Western elongation was reached about September 6th at a distance of over 61' (for distance unity of *Jupiter*). Observations are scattering for nearly two months past, owing to stormy weather, but those available indicate that eastern elongation was passed the latter part of December at a distance of only 43'. This would give 0.18 as the minimum value of the eccentricity. As there are good reasons for believing that the major axis is considerably inclined to the normal to the line of sight, the eccentricity is probably larger than 0.18.

At the time of discovery, early in January, 1905, the seventh satellite had passed western elongation and was moving eastward. Since that time it has passed three elongations, one of which was not observed on account of the proximity of the Sun.

In the case of an orbit of such large eccentricity, it is not satisfactory to try to determine the period from the elongation times available. It is certain, however, that the period of the

seventh satellite will not differ greatly from that of the sixth, whose orbit is much better known at present.

The apparent orbit of the sixth satellite has opened out very much since discovery, while that of the seventh has closed up, so that during the present opposition the Earth is almost exactly in the plane of its orbit. These facts also prove conclusively that the motions of both satellites about their primary are direct.

C. D. FERRINE.

MT. HAMILTON, January 25, 1906.

#### ORBIT OF THE SIXTH SATELLITE OF *JUPITER*.

On account of the accuracy with which this orbit is representing recent observations, it is thought advisable to reprint the elements for the benefit of *A. S. P.* readers. The orbit and ephemeris were derived by Dr. F. E. ROSS, of the Carnegie Institution, Washington, D. C.

C. D. P.

#### ELEMENTS REFERRED TO THE EARTH'S EQUATOR.

Mean jovicentric right ascension.....	289°.1	} 1905.0 Gr. M. T.
Right ascension of perijove.....	270	
Right ascension of node on equator...	176°.7	
Inclination to equator .....	5° 29'	
Semi-major axis (at <i>Jupiter's</i> mean distance) .....	50'.6	
Tropical mean motion .....	1°.435	
Period .....	251 days	
Eccentricity .....	0.156	

#### EPHEMERIS FOR GREENWICH MEAN NOON.

1906.	Position Angle.	Distance.
February 1	99°	60'
6	97	59
11	94	58
16	92	57
21	90	55
26	88	53
March 3	85	50
8	82	47
13	79	43
18	75	39
23	71	35
28	65	31